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Notes:

1. Untranslatable words are replaced with asterisks (***).
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FULL CONTENTS

[Claim(s)]

[Claim 1] While impressing welding voltage and generating arc between a welding wire and a weldment with a welding-source apparatus In robot arc welding of the consumable electrode type which is made to move the welding torch attached to a welding robot's manipulator, and is welded If a welding start signal is inputted, said welding torch will be moved to the welding start location to which it was taught beforehand. After arriving at said welding start location, move said welding torch in the feeding direction of an abbreviation welding wire, and the wire head is brought close to said weldment. Backing movement which is made to move said welding torch to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away said wire head from said weldment while said wire head energizes the initial current of the small current value it was determined beforehand that distinguished having contacted said weldment from said welding-source apparatus is performed. The initial arc which said initial current will energize if said wire head and said weldment separate by said backing movement occurs. It switches to dislodging in the weld direction beforehand taught from said backing movement when said backing movement was continued with said initial arc generation state maintained and said welding torch returned to said welding start location. The arc start control approach of robot arc welding made to shift to a regular arcing condition smoothly from said initial arc generation state by energizing a regular welding current while starting feeding of said welding wire simultaneously.

[Claim 2] While impressing welding voltage and generating arc between a welding wire and a weldment with a welding-source apparatus In robot arc welding of the consumable electrode type which is made to move the welding torch attached to a welding robot's manipulator, and is welded If a welding start signal is inputted, said welding torch will be moved to the welding start location to which it was taught beforehand. After arriving at said welding start location, move said welding torch in the feeding direction of an abbreviation welding wire, and the wire

head is brought close to said weldment. Backing movement which is made to move said welding torch to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away said wire head from said weldment while said wire head energizes the initial current of the small current value it was determined beforehand that distinguished having contacted said weldment from said welding-source apparatus is performed. The initial arc which said initial current will energize if said wire head and said weldment separate by said backing movement occurs. Continue said backing movement, with said initial arc generation state maintained, and if a wire head and the distance between weldments reach retreat distance setting defined beforehand, while switching to carriage return dislodging in said welding start location from said backing movement and starting feeding of said welding wire simultaneously, a regular welding current is energized. After returning to said welding start location, it is the arc start control approach of robot arc welding made to shift to a regular arcing condition smoothly from said initial arc generation state by moving said welding torch in the weld direction to which it was taught beforehand.

[Claim 3] The arc start control approach of Claim 2 which performs feeding initiation of a welding wire, and the energization start of a regular welding current from the event of a welding torch returning to a welding start location by carriage return dislodging.

[Claim 4] It is the arc start control approach of Claim 2 which energizes the migration current of a bigger current value than the welding current in which throughout [said carriage return diakinesis stage] is regular when carriage return dislodging is dislodging in the direction which shortens a wire head and distance between weldments.

[Claim 5] When carriage return dislodging is dislodging in the direction which shortens a wire head and distance between weldments Throughout [said carriage return diakinesis stage] is the arc start control approach of Claim 2 which energizes the migration current beforehand defined corresponding to the rate of said carriage return dislodging with feeding of a welding wire stopped, and energizes a regular welding current while a welding torch starts feeding of said welding wire after returning to a welding start location.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] After it brings a welding wire close to a weldment and this invention contacts it, it is reversed, and it separates a welding wire from a weldment, generates an initial arc, and relates to the arc start control approach of robot arc welding which feeds in the direction which brings a welding wire close to a weldment again, and is made to shift to regular arc.

[0002]

[Description of the Prior Art] While impressing welding voltage and generating arc between a welding wire and a weldment with a welding-source apparatus In robot arc welding of the consumable electrode type which is made to move the welding torch attached to a welding robot's manipulator, and is welded When a welding start signal is inputted from the outside, after moving a welding torch by moving a manipulator to the welding start location Sp to which it was taught beforehand, with an idle state Carry out positive rotation of the wire feeding motor, and advance feeding of the welding wire is carried out to a weldment. If it distinguishes that the welding wire contacted the weldment continuously, will carry out counterrotation of the wire feeding motor, and back space feeding of the welding wire will be carried out. If the initial current Is of a small current value is energized simultaneously, a welding wire separates from a weldment and an initial arc occurs by back space feeding continuously, while carrying out advance feeding of the welding wire again at the regular feeding rate Ws, the regular welding current Ic is energized. The arc start control approach made to shift to regular arc is known from the former by switching a welding torch to dislodging in the weld direction to which it was beforehand taught from the above-mentioned idle state simultaneously. The arc start control approach of this conventional technique is hereafter explained with reference to Drawings.

[0003] Drawing 2 is the block diagram of the robot arc-welding apparatus of the conventional technique. With reference to this drawing, it explains hereafter. [the control device] if the robot control device RC is inputted [the welding start signal St] from the outside, while outputting the motion-control signal Mc which performs motion control of Manipulator RM The interface signal If formed by the electrical-potential-difference setpoint signal Vs, the regular feeding speed setting signal Ws, and the output start signal On which are later mentioned by drawing 3 is transmitted to the welding-source apparatus PS. Manipulator RM carries the wire feeding motor WM and the welding torch 4, and is made to move them along with the locus of operation to which the tip position (TCP) of the welding torch 4 was beforehand taught according to the above-mentioned motion-control signal Mc. a welding wire -- one -- the above -- a wire -- feeding -- a motor -- WM -- the above -- a welding torch -- four -- a body -- between -- tying -- die length -- 1.5 -- [-- m --] -- a grade -- a coil -- a liner -- four -- a -- inside -- passing - - feeding -- having .

[0004] The welding-source apparatus PS receives the above-mentioned interface signal If, supplies electric power to the welding wire 1 in the welding voltage Vw through the contact tip with which it was equipped at the head of the welding torch 4, generates arc 3 between the welding wire 1 and a weldment 2, and energizes the welding current Iw to it. Similarly, this welding-source apparatus PS outputs the feeding control signal Fc, and controls the above-mentioned hand of cut and above-mentioned rotating speed of the wire feeding motor WM. The distances of the head of the welding wire 1 and a weldment 2 are a wire head and the

distance L_w between weldments [mm], therefore, in the inside of arcing, this wire head and the distance L_w between weldments become the same as that of arc length.

[0005] Drawing 3 is the block diagram of the robot control device RC and the welding-source apparatus PS mentioned above by drawing 2. With reference to this drawing, each circuit block is explained hereafter. The robot control device RC consists of the following circuit blocks. The motion-control circuit MC will output the motion-control signal M_c to which Manipulator RM is moved along with the locus of operation to which it was taught beforehand to the motor of each shaft of Manipulator RM, if the welding start signal St is inputted. This motion-control circuit MC outputs the electrical-potential-difference setpoint signal V_s , the regular feeding speed setting signal W_s , and the output start signal On to robot interface circuit IFR simultaneously. Robot interface circuit IFR transmits the interface signal If formed from the three above-mentioned signals to the welding-source apparatus PS.

[0006] On the other hand, the welding-source apparatus PS consists of the following circuit blocks. The voltage detector VD detects the welding voltage V_w , and outputs the electrical-potential-difference detection signal V_d . By considering the above-mentioned electrical-potential-difference detection signal V_d as an input, a short circuit / arc discrimination circuit SA outputs a short circuit signal (High level), when between a welding wire and weldments is in a contact condition, and it outputs an arcing signal (Low level) as a short circuit / an arc discrimination signal S_a in an arcing condition. Since the timing again switched to advance feeding after initial arc birth is delayed, the delay circuit DT outputs the delay signal D_t with which during the time delay T_d beforehand set from the event of above-mentioned short circuit / arc discrimination signal S_a changing from a short circuit signal to an arcing signal serves as a High level.

[0007] The welding-source interface circuit IFP receives the above-mentioned interface signal If , and outputs the electrical-potential-difference setpoint signal V_s , the regular feeding speed setting signal W_s , and the output start signal On . [the right reverse feeding controlling circuit RFC] if the above-mentioned output start signal On is inputted (High level) Carry out advance feeding of the welding wire to a weldment, and if above-mentioned short circuit / arc discrimination signal S_a turn into a short circuit signal continuously, back space feeding of the welding wire will be carried out from a weldment. If the above-mentioned delay signal D_t changes from a High level to a Low level continuously, the feeding control signal F_c for carrying out advance feeding of the welding wire to a weldment again at the feeding rate equivalent to the above-mentioned regular feeding speed setting signal W_s will be outputted. The wire feeding motor WM feeds [advance-] or feeds [back-space-] a welding wire according to the above-mentioned feeding control signal F_c .

[0008] The power control circuit INV outputs the welding voltage and the welding current for which it was suitable in order to maintain arc stably by inverter control, thyristor phase control,

etc. by considering commercial power (usually three phases 200V) as an input. From the event of the above-mentioned output start signal On being inputted, this power control circuit INV forms the constant current characteristic or drooping characteristic which energizes the initial current I_s of the small current value as which the above-mentioned delay signal Dt determined beforehand between the events of changing from a High level to a Low level, and outputs. The constant voltage characteristic corresponding to the above-mentioned electrical-potential-difference setpoint signal Vs for energizing the regular welding current I_c corresponding to the above-mentioned regular feeding speed setting signal Ws is formed and outputted after it.

[0009] Drawing 4 is the timing chart of each signal of the robot control device RC and the welding-source apparatus PS mentioned above by drawing 3. This drawing (A) shows time change of the welding start signal St, and this drawing (B) shows time change of the output start signal On. This drawing (C) shows time change of the feeding control signal Fc, and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa. This drawing (E) shows time change of the delay signal Dt, this drawing (F) shows time change of the welding current I_w , this drawing (G) shows time change of a wire head and the distance L_w between weldments, and the feeding condition of the welding wire 1 in each [this drawing (H1) - (H5)] time is shown. With reference to this drawing, it explains hereafter.

[0010] ** in the period time t1 of time t1-t2 as shown in this drawing (A) If the welding start signal St is inputted from the outside (High level), the welding torch 4 attached to the manipulator is moved, and in time t2, the welding torch 4 will arrive at the welding start location Sp taught beforehand, and will stop.

[0011] ** In the period time t2 of time t2-t3, if the welding torch 4 arrives at the welding start location Sp, as shown in this drawing (B), the output start signal On will be outputted from the motion-control circuit Mc mentioned above (High level). According to this, as are shown in this drawing (C), and the feeding control signal Fc serves as the initial feeding speed setting value W_i of the forward value defined beforehand and is shown in this drawing (H1), advance feeding of the welding wire 1 is carried out at an initial feeding rate to a weldment 2. In addition, when the feeding control signal Fc is a forward value, it becomes advance feeding, and it becomes back space feeding at the time of a negative value. Although the power control circuit INV mentioned above is forming and outputting the constant current characteristic or the drooping characteristic simultaneously, since the welding wire 1 and the weldment 2 are separated and are in unloaded condition, a no-load voltage impresses during this period. Moreover, as the above-mentioned advance feeding shows to this drawing (G) during the period of time t2-t3, a wire head and the distance L_w between weldments become short gradually.

[0012] ** In the period time t3 of time t3-t4, if the welding wire 1 contacts a weldment 2 by advance feeding of the above-mentioned ** term as shown in this drawing (H2), as shown in

this drawing (D), a short circuit / arc discrimination signal Sa will change to a short circuit signal (High level). According to this, as shown in this drawing (C), the feeding control signal Fc serves as the back space feeding speed setting value Wr of the negative value defined beforehand, and back space feeding of the welding wire 1 is carried out at a back space feeding rate from a weldment 2. Simultaneously, as shown in this drawing (F), the initial current Is of a small current value energizes with the constant current characteristic or drooping characteristic mentioned above by ** term. The value of this initial current Is is set as the small current value about number [A] - several 10 [A]. Moreover, motor response delay time for the wire feeding motor WM mentioned above to be reversed from positive rotation (advance feeding) to counterrotation (back space feeding) occurs during the time t3-t4. Furthermore, the play part response delay time for canceling a part for the play by the deflection of the coil liner mentioned above by back space feeding also occurs. For this reason, as the welding wire 1 and a weldment 2 are still contact conditions and it is shown in this drawing (G) during this period, a wire head and the distance Lw between weldments are still 0 [mm].

[0013] ** If the welding wire 1 and a weldment 2 separate by back space feeding of the above-mentioned ** term as shown in this drawing (H3) immediately after the period time t4 of time t4-t5, the initial arc 3a which the above-mentioned initial current Is energizes will occur. Moreover, as before the time t5 when the time delay Td mentioned above from the time t4 when the initial arc 3a occurred passes is shown in this drawing (E), the delay signal Dt is still a High level. And back space feeding is continued, maintaining the above-mentioned initial arc generation state 3a in the meantime, as shown in this drawing (H4). Therefore, as shown in this drawing (G), a wire head and the distance Lw between weldments become long gradually.

[0014] ** in the period time t5 after time t5 as shown in this drawing (E) If the delay signal Dt changes from a High level to a Low level, as shown in this drawing (C), the feeding control signal Fc will turn into the regular feeding speed setting signal Ws of a forward value, and advance feeding of the welding wire 1 will be again carried out at a regular feeding rate to a weldment 2. Since the power control circuit INV mentioned above forms the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal Vs simultaneously As shown in this drawing (F), the regular welding current Ic of the high current value corresponding to the above-mentioned regular feeding rate Ws energizes the welding voltage which is not illustrated, while it serves as a value equivalent to the above-mentioned electrical-potential-difference setpoint signal Vs. The welding torch 4 is simultaneously switched to dislodging in the weld direction to which it was beforehand taught from the idle state.

[0015] However, also in this time t5, motor response delay time and play part response delay time occur like time [which was mentioned above] t3 - t four-term period (time t5-t6).

Therefore, as shown in this drawing (G), in time t_6 , it converges on regular arc length, and a wire head and the distance L_w between weldments shift to the regular arc 3b of the time t_6 shown in this drawing (H5) from the initial arc 3a of the time t_5 shown in this drawing (H4).

[0016]

[Problem to be solved by the invention] Drawing 5 is a timing chart equivalent to drawing 4 mentioned above for explaining the settlement technical problem of the conventional technique. This drawing (A) shows time change of the welding start signal St , and this drawing (B) shows time change of the output start signal On . This drawing (C) shows time change of the feeding control signal Fc , and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa . This drawing (E) shows time change of the delay signal Dt , this drawing (F) shows time change of the welding current I_w , this drawing (G) shows time change of a wire head and the distance L_w between weldments, and the feeding condition of the welding wire 1 in each [this drawing (H1) - (H5)] time is shown. In this drawing, since the action of time t_3 - t_4 and time t_5 - periods other than t_6 is the same as that of the time of drawing 4 mentioned above, the description is omitted. Both the periods of the time t_3 - t_4 of this drawing and time t_5 - t_6 are hereafter explained with reference to this drawing.

[0017] ** The period of time t_3 - t_4 (1st response delay time T_1)

In time t_3 as shown in this drawing (H2) as mentioned above by the term of description of drawing 4 If the welding wire 1 and a weldment 2 contact, as shown in this drawing (D), a short circuit / arc discrimination signal Sa changes to a short circuit signal (High level), it will be reversed from advance feeding and the welding wire 1 will switch to back space feeding. Motor response delay time for the wire feeding motor WM shown in drawing 3 at this time to switch from the positive rotation of advance feeding to the counterrotation of back space feeding occurs. Furthermore, as mentioned above, the play part response delay time for canceling a part for the play by the deflection of the coil liner which connects the wire feeding motor WM and a welding torch body by back space feeding occurs. That time length changes with the grades of the deflection of a coil liner that this play part response delay time originates in the die length of a coil liner, and various positions of weld etc., a lot. It plays with the above-mentioned motor response delay time, part response delay time is added, and it becomes the 1st response delay time T_1 . As are shown in this drawing (H3) immediately after the time t_4 after this 1st response delay time T_1 progress, and the welding wire 1 and a weldment 2 separate, the initial arc 3a occurs and it is shown in this drawing (G) by original back space feeding, a wire head and the distance L_w between weldments become long gradually after it. Usually, the 1st above-mentioned response delay time T_1 is 300-500 [ms] grade.

[0018] ** The period of time t_5 - t_6 (2nd response delay time T_2)

In time t_5 , if the delay signal Dt changes from a High level to a Low level, with an initial arc generation state maintained as shown in this drawing (E) as shown in this drawing (H4), it will

be reversed from back space feeding, and the welding wire 1 will switch to advance feeding. Motor response delay time for the wire feeding motor WM to switch from the counterrotation of back space feeding to the positive rotation of advance feeding occurs like the above-mentioned ** term also at this time. Furthermore, the play part response delay time for canceling a part for the play by the deflection of a coil liner by advance feeding occurs. It plays with the above-mentioned motor response delay time, part response delay time is added, and it becomes the 2nd response delay time T2. Usually, this 2nd response delay time T2 is also 300-500 [ms] grade.

[0019] The 1st settlement technical problem is as follows. As throughout [response delay time T two term] is shown in this drawing (F), the regular welding current I_c of a bigger current value than initial current I_s is energizing, but another side and the feeding rate of the welding wire serve as a transitional value smaller than a steady-state value by the above-mentioned response delay time. [of ** the 2nd of the above-mentioned time t_5 - t_6] Since [for this reason,] it becomes larger than a feeding rate with a transitional melting rate by the regular welding current I_c As are shown in this drawing (G), and arc length (a wire head and distance L_w between weldments) becomes long and time t_5 or later are shown in this drawing (H5) in it, it melts and falls with the arc 3c of excessive arc length, and the weld defect of a poor bead arises. This 1st settlement technical problem is hereafter called poor weld by the arc length impudence during response delay time.

[0020] Furthermore, the 2nd settlement technical problem is as follows. Response delay time T_1+T_2 of the aggregate value of the 1st response delay time T_1 and the 2nd response delay time T_2 which were mentioned above are set to 600-1000 [ms]. This unnecessary time is needed for every arc start. Generally in weld of a machine part, autoparts, etc., only a short time for about several seconds performs several many welds which generate arc in many cases. In weld, it is [excessive time] bad necessary [600-1000 [ms]] for productivity for every arc start such many times [short-time]. This settlement technical problem is hereafter called lowering of the productivity by response delay time.

[0021] So, in this invention, the arc start control approach of robot arc welding that birth of the poor weld by the arc length impudence during the response delay time mentioned above can be prevented, lowering of the productivity by response delay time can also be prevented, and a good arc start can be realized is offered.

[0022]

[Means for solving problem] [invention] as shown in drawing 6 - 7, while invention of Claim 1 at the time of application impresses the welding voltage V_w and generates arc between the welding wire 1 and a weldment 2 with the welding-source apparatus PS In robot arc welding of the consumable electrode type which is made to move the welding torch 4 attached to a welding robot's manipulator RM, and is welded If the welding start signal St is inputted, the

above-mentioned welding torch 4 will be moved to the welding start location Sp to which it was taught beforehand. After arriving at the above-mentioned welding start location Sp, move the above-mentioned welding torch 4 in the feeding direction of an abbreviation welding wire, and the wire head is brought close to the above-mentioned weldment 2. While the above-mentioned wire head energizes the initial current Is of the small current value it was determined beforehand that distinguished having contacted the above-mentioned weldment 2 from the above-mentioned welding-source apparatus PS The initial arc 3a which the above-mentioned initial current Is will energize if backing movement which is made to move the above-mentioned welding torch 4 to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away the above-mentioned wire head from the above-mentioned weldment 2 is performed and the above-mentioned wire head and the above-mentioned weldment 2 separate by the above-mentioned backing movement occurs. It switches to dislodging in the weld direction beforehand taught from the above-mentioned backing movement when the above-mentioned backing movement was continued with the above-mentioned initial arc generation state 3a maintained and the above-mentioned welding torch 4 returned to the above-mentioned welding start location Sp. While starting feeding of the above-mentioned welding wire 1 simultaneously, it is the arc start control approach of robot arc welding made to shift to the regular arcing condition 3b smoothly from the above-mentioned initial arc generation state 3a by energizing the regular welding current Ic.

[0023] [invention] as shown in drawing 8 - 9, while invention of Claim 2 at the time of application impresses the welding voltage Vw and generates arc between the welding wire 1 and a weldment 2 with the welding-source apparatus PS In robot arc welding of the consumable electrode type which is made to move the welding torch 4 attached to a welding robot's manipulator RM, and is welded If the welding start signal St is inputted, the above-mentioned welding torch 4 will be moved to the welding start location Sp to which it was taught beforehand. After arriving at the above-mentioned welding start location Sp, move the above-mentioned welding torch 4 in the feeding direction of an abbreviation welding wire, and the wire head is brought close to the above-mentioned weldment 2. While the above-mentioned wire head energizes the initial current Is of the small current value it was determined beforehand that distinguished having contacted the above-mentioned weldment 2 from the above-mentioned welding-source apparatus PS The initial arc 3a which the above-mentioned initial current Is will energize if backing movement which is made to move the above-mentioned welding torch 4 to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away the above-mentioned wire head from the above-mentioned weldment 2 is performed and the above-mentioned wire head and the above-mentioned weldment 2 separate by the above-mentioned backing movement occurs. Continue the above-mentioned backing movement, with the above-mentioned initial arc generation state 3a

maintained, and if a wire head and the distance L_w between weldments reach the retreat distance setting L_s defined beforehand, it will switch to carriage return dislodging in the above-mentioned welding start location S_p from the above-mentioned backing movement. While starting feeding of the above-mentioned welding wire 1 simultaneously, the regular welding current I_c is energized. After returning to the above-mentioned welding start location S_p , it is the arc start control approach of robot arc welding made to shift to the regular arcing condition 3b smoothly from the above-mentioned initial arc generation state 3a by moving the above-mentioned welding torch 4 in the weld direction to which it was taught beforehand.

[0024] Invention of Claim 3 at the time of application is the arc start control approach of Claim 2 at the time of the application which performs the feeding initiation of the welding wire 1 and the energization start of the regular welding current I_c which are indicated to Claim 2 at the time of application from the event of the welding torch 4 returning to the welding start location S_p by carriage return dislodging, as shown in drawing 10 .

[0025] [invention of Claim 4 at the time of application] as shown in drawing 11 - 12, when carriage return dislodging indicated to Claim 2 at the time of application is dislodging in the direction which shortens a wire head and distance L_w between weldments It is the arc start control approach of Claim 2 at the time of the application which energizes migration current I_{b1} of a bigger current value than the regular welding current I_c during between [above-mentioned / T_b] carriage return diakinesis stages.

[0026] [invention of Claim 5 at the time of application] as shown in drawing 13 - 14, when carriage return dislodging indicated to Claim 2 at the time of application is dislodging in the direction which shortens a wire head and distance L_w between weldments Migration current I_{b2} beforehand defined corresponding to the rate of the above-mentioned carriage return dislodging with feeding of the welding wire 1 stopped are energized during between [above-mentioned / T_b] carriage return diakinesis stages. After the welding torch's 4 returning to the welding start location S_p , while starting feeding of the above-mentioned welding wire 1, it is the arc start control approach of Claim 2 at the time of the application which energizes the regular welding current I_c .

[0027]

[Mode for carrying out the invention] [an example of the form of operation of this invention] as shown in drawing 1 (the same drawing as drawing 7) If the welding start signal S_t is inputted from the exterior as shown in this drawing (A) Make it move to the welding start location S_p to which it was taught beforehand, and the welding torch 4 after arriving at the above-mentioned welding start location S_p (time t_2) As the above-mentioned welding torch 4 is moved in the feeding direction of an abbreviation welding wire, the wire head is brought close to a weldment 2 and it is shown in this drawing (D) While a wire head energizes the initial current I_s of the small current value it was determined beforehand that distinguished having contacted the

weldment 2 (time t_3) Backing movement which is made to move the above-mentioned welding torch 4 to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away a wire head from a weldment 2 is performed. As shown in this drawing (H3) if a wire head and a weldment 2 separate by the above-mentioned backing movement (time t_4) The above-mentioned backing movement is continued the initial arc 3a which the above-mentioned initial current I_s energizes occurring, and maintaining the above-mentioned initial arc generation state 3a. By energizing the regular welding current I_c if the above-mentioned welding torch 4 returns to the above-mentioned welding start location S_p (time t_5), while switching to dislodging in the weld direction beforehand taught from the above-mentioned backing movement and starting feeding of the welding wire 1 simultaneously It is the arc start control approach of robot arc welding made to shift to the regular arcing condition 3b shown in this drawing (H5) from the initial arc generation state 3a shown in this drawing (H4) smoothly. [0028]

[Working example] [Work example 1] Invention of a work example 1 explained below corresponds to invention of Claim 1 at the time of application. [invention of a work example 1] in robot arc welding if a ** welding start signal is inputted If a ** welding torch is moved in the feeding direction of an abbreviation welding wire, the wire head is brought close to a weldment and a ** wire head contacts a weldment, after moving a welding torch to the welding start location S_p to which it was taught beforehand While energizing the initial current I_s of the small current value defined beforehand, backing movement which is made to move a welding torch to a reverse direction with the feeding direction of an abbreviation welding wire, and keeps away a wire head from a weldment is performed. ** If a wire head and a weldment separate by the above-mentioned backing movement, the initial arc which the above-mentioned initial current I_s energizes will occur. The above-mentioned backing movement is continued with the above-mentioned initial arc generation state maintained. ** When a welding torch returns to the above-mentioned welding start location S_p , while switching to dislodging in the weld direction beforehand taught from the above-mentioned backing movement and starting feeding of a welding wire simultaneously, it is the arc start control approach which energizes the regular welding current I_c . Invention of a work example 1 is hereafter explained with reference to Drawings.

[0029] Drawing 6 is the block diagram of the robot control device RC for enforcing the arc start control approach of a work example 1, and the welding-source apparatus PS. In this drawing, the same code is given to the same circuit block as drawing 3 mentioned above, and those description is omitted. Drawing 3 enclosed with a dotted line explains hereafter the synchronous operation controlling circuit SMC of operation which is a different circuit block, synchronous robot interface circuit SIFR of operation, synchronous welding-source interface circuit SIFP of operation, the synchronous feeding controlling circuit SFC of operation, and the

synchronous power control circuit SINV of operation.

[0030] [the controlling circuit] while the synchronous operation controlling circuit SMC of operation outputs the electrical-potential-difference setpoint signal V_s and the regular feeding speed setting signal W_s which were beforehand set that the welding start signal St is inputted from the outside If Manipulator RM (welding torch 4) is moved to the welding start location Sp , and it carries out after arriving at the welding start location Sp If Manipulator RM is moved in the abbreviation feeding direction and a short circuit / arc discrimination signal Sa turns into a short circuit signal, while outputting the output start signal On If backing movement of the manipulator RM is carried out and it returns to the welding start location Sp , while outputting the return signal Rp , the motion-control signal Mc moved in the weld direction to which Manipulator RM was taught will be outputted.

[0031] Synchronous robot interface circuit SIFR of operation communicates the interface signal If formed from five signals, the above-mentioned electrical-potential-difference setpoint signal V_s , the regular feeding speed setting signal W_s , the output start signal On , the short circuit / arc discrimination signal Sa , and the return signal Rp , between the welding-source apparatus PS.

[0032] Synchronous welding-source interface circuit SIFP of operation communicates the interface signal If formed from the five above-mentioned signals between the robot control devices RC. The synchronous feeding controlling circuit SFC of operation will output the feeding control signal Fc which carries out advance feeding of the welding wire at the feeding rate equivalent to the above-mentioned regular feeding speed setting signal W_s , if the above-mentioned return signal Rp is inputted. Form the constant current characteristic or drooping characteristic which energizes the initial current I_s of the small current value as which the synchronous power control circuit SINV of operation determined beforehand between the event of the above-mentioned output start signal On being inputted, and the event of the above-mentioned return signal Rp being inputted, and it outputs. The constant voltage characteristic corresponding to the above-mentioned electrical-potential-difference setpoint signal V_s for energizing the regular welding current I_c corresponding to the above-mentioned regular feeding speed setting signal W_s is formed and outputted after it.

[0033] Drawing 7 is the timing chart of each signal of the robot control device RC of a work example 1, and the welding-source apparatus PS mentioned above by drawing 6 . This drawing (A) shows time change of the welding start signal St , and this drawing (B) shows time change of the output start signal On . This drawing (C) shows time change of the feeding control signal Fc , and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa . This drawing (E) shows time change of the return signal Rp , this drawing (F) shows time change of the welding current I_w , this drawing (G) shows time change of a wire head and the distance L_w between weldments, and the feeding condition of the welding wire 1 in each

[this drawing (H1) - (H5)] time is shown. In this drawing, drawing 3 (E) and the delay signal Dt of drawing 4 (E) which were mentioned above have replaced the return signal Rp. With reference to this drawing, it explains hereafter.

[0034] ** in the period time t1 of time t1-t2 as shown in this drawing (A) If the welding start signal St is inputted from the outside (High level), the welding torch 4 carried in the manipulator will be moved, and as shown in this drawing (H1), in time t2, the welding torch 4 will arrive and stop to the welding start location Sp taught beforehand.

[0035] ** In the period time t2 of time t2-t3, if the welding torch 4 arrives at the welding start location Sp, as shown in this drawing (B), the output start signal On will be outputted from the synchronous operation controlling circuit SMC of operation mentioned above (High level). Although the synchronous power control circuit SINV of operation mentioned above forms and outputs a constant current characteristic or a drooping characteristic, stopping feeding of the welding wire 1 according to this, since the welding wire 1 and the weldment 2 are separated and are in unloaded condition, a no-load voltage impresses during this period. Simultaneously, the welding torch 4 is moved in the feeding direction of an abbreviation welding wire, and the wire head is brought close to a weldment 2. Therefore, as shown in this drawing (G), a wire head and the distance Lw between weldments become short gradually.

[0036] ** In the period time t3 of time t3-t4, if a wire head contacts a weldment 2 by dislodging of the welding torch 4 of the above-mentioned ** term as shown in this drawing (H2), as shown in this drawing (D), a short circuit / arc discrimination signal Sa will change to a short circuit signal (High level). According to this change, backing movement of the welding torch 4 is carried out to the feeding direction of an abbreviation welding wire to a reverse direction. Simultaneously, as shown in this drawing (F), the initial current Is of a small current value energizes with the constant current characteristic or drooping characteristic mentioned above by ** term. Moreover, during the time t3-t4, although backing movement of the welding torch 4 is carried out, the welding wire 1 and a weldment 2 are still contact conditions by the 1st response delay time T11 by the response delay time of the motor of a manipulator. Therefore, as shown in this drawing (G), a wire head and the distance Lw between weldments are still 0 [mm]. However, the 1st above-mentioned response delay time T11 plays with the motor response delay time mentioned above by the term of description of drawing 5 , and is time shorter than the 1st response delay time T1 which is the aggregate value of part response delay time, and the value is usually a below 100[ms] grade.

[0037] ** In the period time t4 of time t4-t5, as shown in this drawing (H3), if a wire head and a weldment 2 separate, the initial arc 3a which the above-mentioned initial current Is energizes will occur by the backing movement of the above-mentioned ** term. Moreover, before the time t5 when the welding torch 4 returns to the welding start location Sp from the time t4 when the initial arc 3a occurred continues the above-mentioned backing movement. Therefore, as

shown in this drawing (G), a wire head and the distance L_w between weldments become long gradually.

[0038] ** In the period time t_5 after time t_5 , if the welding torch 4 returns to the welding start location Sp by the backing movement of the above-mentioned ** term, as shown in this drawing (E), the return signal Rp will be outputted (High level). According to this, as shown in this drawing (C), the feeding control signal Fc turns into the regular feeding speed setting signal Ws of a forward value, and advance feeding of the welding wire 1 is carried out to a weldment 2. [the synchronous power control circuit $SINV$ of operation mentioned above] simultaneously Since the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal Vs is formed, as shown in this drawing (F), the regular welding current Ic of the high current value corresponding to the above-mentioned regular feeding rate Ws energizes the welding voltage Vw which is not illustrated, while it serves as a value equivalent to the above-mentioned electrical-potential-difference setpoint signal Vs . The welding torch 4 ***** dislodging in the weld direction taught beforehand simultaneously.

[0039] In time t_5 , the response delay time of the motor of the manipulator for switching the welding torch 4 to dislodging in the weld direction from backing movement and the response delay time of a wire feeding motor occur. However, since, as for a manipulator, the dislodging direction only changes, the response delay time by this is short. On the other hand, since a wire feeding motor is only initiation of the positive rotation instead of inversion from counterrotation to positive rotation like the conventional technique, the response delay time by this is short. Therefore, the 2nd response delay time T_{21} of this invention which is the above-mentioned aggregate value becomes shorter than the 2nd response delay time T_2 of the conventional technique, and the value is usually below 100 [ms]. For this reason, since it shifts to the regular arc 3b shown in this drawing (H5) from the initial arc 3a shown in this drawing (H4) after progress of the short period T_{21} of time t_5 - t_6 smoothly, the poor weld by the arc length impedance during the response delay time mentioned above is not generated.

Furthermore, since response delay time $T_{11}+T_{21}$ of the sum of this invention are 1 / three to 1/5 or less time compared with response delay time T_1+T_2 of the conventional technique, they can also prevent lowering of the productivity by response delay time.

[0040] [Work example 2] Invention of a work example 2 explained below corresponds to invention of Claim 2 at the time of application. [invention of a work example 2 / with the initial arc generation state in invention of the ** work example 1 maintained / with the backing movement of a welding torch] If a wire head and the distance L_w between weldments reach the retreat distance setting L_s defined beforehand If the regular welding current Ic is energized and a ** welding torch returns to the welding start location Sp , while switching to carriage return dislodging in the welding start location Sp from the above-mentioned backing movement and starting feeding of a welding wire simultaneously It is the arc start control approach

switched to dislodging in the weld direction beforehand taught from the above-mentioned carriage return dislodging. Invention of a work example 2 is hereafter explained with reference to Drawings.

[0041] Drawing 8 is the block diagram of the robot control device RC for enforcing the arc start control approach of a work example 2, and the welding-source apparatus PS. In this drawing, the same code is given to the same circuit block as drawing 6 mentioned above, and those description is omitted. Drawing 6 enclosed with a dotted line explains hereafter the synchronous operation controlling circuit SMC of operation which is a different circuit block, synchronous robot interface circuit SIFR of operation, synchronous welding-source interface circuit SIFP of operation, the synchronous feeding controlling circuit SFC of operation, and the synchronous power control circuit SINV of operation.

[0042] [the controlling circuit] while the synchronous operation controlling circuit SMC of a work example 2 of operation outputs the electrical-potential-difference setpoint signal Vs and the regular feeding speed setting signal Ws which were beforehand set that the welding start signal St is inputted from the outside If Manipulator RM (welding torch 4) is moved to the welding start location Sp and it arrives at the welding start location Sp If Manipulator RM is moved in the abbreviation feeding direction and a short circuit / arc discrimination signal Sa turns into a short circuit signal, while outputting the output start signal On If the retreat distance setting Ls which was made to carry out backing movement of the manipulator RM, and differed in the work example 1, and the wire head and the distance Lw between weldments defined beforehand by the above-mentioned backing movement is reached While outputting the retreat distance coincidence signal Lp, the above welding start location Sp is made to carry out carriage return dislodging of the manipulator RM, and the motion-control signal Mc moved in the weld direction taught after returning to the welding start location Sp is outputted.

[0043] [synchronous robot interface circuit SIFR of a work example 2 of operation] The interface signal If formed from five signals of a retreat distance coincidence signal Lp which is different in the electrical-potential-difference setpoint signal Vs, the regular feeding speed setting signal Ws, the output start signal On, the above-mentioned short circuit / arc discrimination signal Sa, and an above-mentioned work example 1 is communicated between the welding-source apparatus PS.

[0044] Synchronous welding-source interface circuit SIFP of a work example 2 of operation communicates the interface signal If formed from the five above-mentioned signals between the robot control devices RC. The synchronous feeding controlling circuit SFC of a work example 2 of operation will output the feeding control signal Fc which carries out advance feeding of the welding wire at the feeding rate equivalent to the above-mentioned regular feeding speed setting signal Ws, if the above-mentioned retreat distance coincidence signal Lp is inputted. [the synchronous power control circuit SINV of a work example 2 of operation]

The constant current characteristic or drooping characteristic which energizes the initial current I_s of the small current value defined beforehand is formed and outputted between the event of the above-mentioned output start signal On being inputted, and the event of the above-mentioned retreat distance coincidence signal L_p being inputted. The constant voltage characteristic corresponding to the above-mentioned electrical-potential-difference setpoint signal V_s for energizing the regular welding current I_c corresponding to the above-mentioned regular feeding speed setting signal W_s is formed and outputted after it.

[0045] Drawing 9 is the timing chart of each signal of the robot control device RC of a work example 2, and the welding-source apparatus PS mentioned above by drawing 8. This drawing (A) shows time change of the welding start signal St , and this drawing (B) shows time change of the output start signal On . This drawing (C) shows time change of the feeding control signal Fc , and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa . In a work example 1, it differs, and this drawing (F) shows time change of the welding current I_w , this drawing (E) shows time change of the retreat distance coincidence signal L_p , and the feeding condition of the welding wire 1 in each [this drawing (H1) - (H5)] time is shown [this drawing (G) shows time change of a wire head and the distance L_w between weldments, and]. In this drawing, in order to show the original effectiveness of a work example 2, a wire head and the distance L_w between weldments when the welding torch 4 arrives at the welding start location Sp first are under about 3 [mm], or 0 [mm] (contact) and a very short case. With reference to this drawing, it explains hereafter.

[0046] ** in the period time t_1 of time t_1 - t_2 as shown in this drawing (A) If the welding start signal St is inputted from the outside (High level), the welding torch 4 carried in the manipulator will be moved, and as shown in this drawing (H1), in time t_2 , the welding torch 4 will arrive and stop to the welding start location Sp taught beforehand.

[0047] ** In the period time t_2 of time t_2 - t_3 , if the welding torch 4 arrives at the welding start location Sp , as shown in this drawing (B), the output start signal On will be outputted from the synchronous operation controlling circuit SMC of operation mentioned above (High level). Although the synchronous power control circuit $SINV$ of operation mentioned above forms and outputs a constant current characteristic or a drooping characteristic, stopping feeding of the welding wire 1 according to this, since the welding wire 1 and the weldment 2 are separated and are in unloaded condition, a no-load voltage impresses during this period. Simultaneously, the welding torch 4 is moved in the feeding direction of an abbreviation welding wire, and the wire head is brought close to a weldment 2. At this time, as mentioned above, since the wire head and the distance L_w between weldments of time t_2 are very short, as shown in this drawing (G), it is set to 0 [mm] for a short time.

[0048] ** In the period time t_3 of time t_3 - t_4 , if a wire head contacts a weldment 2 by dislodging of the welding torch 4 of the above-mentioned ** term as shown in this drawing (H2), as shown

in this drawing (D), a short circuit / arc discrimination signal S_a will change to a short circuit signal (High level). According to this change, backing movement of the welding torch 4 is carried out to the feeding direction of an abbreviation welding wire to a reverse direction. Simultaneously, as shown in this drawing (F), the initial current I_s of a small current value energizes with the constant current characteristic or drooping characteristic mentioned above by ** term. Moreover, during the time t_3 - t_4 , although backing movement of the welding torch 4 is carried out, the welding wire 1 and a weldment 2 are still contact conditions by the 1st response delay time T_{11} by the response delay time of the motor of a manipulator. Therefore, as shown in this drawing (G), a wire head and the distance L_w between weldments are still 0 [mm]. However, like a work example 1, the 1st above-mentioned response delay time T_{11} plays with the motor response delay time mentioned above by the term of description of drawing 5, and is time shorter than the 1st response delay time T_1 which is the aggregate value of part response delay time, and the value is usually a below 100[ms] grade.

[0049] ** In the period time t_4 of time t_4 - t_5 , if a wire head and a weldment 2 separate by the backing movement of the above-mentioned ** term as shown in this drawing (H3), the initial arc 3a which the above-mentioned initial current I_s energizes will occur. Moreover, before the time t_5 when a wire head and the distance L_w between weldments reach the retreat distance setting L_s defined beforehand from the time t_4 when the initial arc 3a occurred continues the above-mentioned backing movement. Therefore, as shown in this drawing (G), a wire head and the distance L_w between weldments become long gradually, and becomes equal to the retreat distance setting L_s in time t_5 .

[0050] ** In the period time t_5 after time t_5 , if a wire head and the distance L_w between weldments reach the retreat distance setting L_s by the backing movement of the above-mentioned ** term, as shown in this drawing (E), back space ***** L_p will be outputted (High level). According to this, as shown in this drawing (C), the feeding control signal F_c turns into the regular feeding speed setting signal W_s of a forward value, and advance feeding of the welding wire 1 is carried out to a weldment 2. Since the synchronous power control circuit SINV of operation mentioned above forms the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal V_s simultaneously As shown in this drawing (F), the regular welding current I_c of the high current value corresponding to the above-mentioned regular feeding rate W_s energizes the welding voltage V_w which is not illustrated, while it serves as a value equivalent to the above-mentioned electrical-potential-difference setpoint signal V_s . Simultaneously, carriage return dislodging of the welding torch 4 is carried out to the welding start location S_p , and after returning to time t_{51} , dislodging is ***** (ed) in the weld direction taught beforehand.

[0051] In time t_5 , the response delay time of the motor of the manipulator for switching the welding torch 4 to dislodging in the weld direction through carriage return dislodging in the

method welding start location Sp of backing movement and the response delay time of a wire feeding motor occur like a work example 1. However, since, as for a manipulator, the dislodging direction only changes, the motor response delay time by this is short. On the other hand, a wire feeding motor is not reversed from counterrotation to positive rotation like the conventional technique, but since it is only initiation of positive rotation, the response delay time by this is short. Therefore, the 2nd response delay time T21 of this invention which is the above-mentioned aggregate value becomes shorter than the 2nd response delay time T2 of the conventional technique, and the value is usually below 100 [ms]. For this reason, since it shifts to the regular arc 3b shown in this drawing (H5) from the initial arc 3a shown in this drawing (H4) after progress of the short period T21 of time t5-t6 smoothly, the poor weld by the arc length impedance during the response delay time mentioned above is not generated. Furthermore, since response delay time T11+T21 of the sum of this invention are 1 / three to 1/5 or less time compared with response delay time T1+T2 of the conventional technique, they can also prevent lowering of the productivity by response delay time.

[0052] Furthermore, in the work example 1, backing movement is continued until it returns to the welding start location Sp. for this reason, when [whose wire head and distance Lw between weldments when arriving at the welding start location Sp first are very short] in contact [case or] Since backing movement of proper distance cannot be performed, the phenomenon which the initial arc 3a does not generate at all, or the phenomenon extinguished by re-contact even if it generates may arise, and it may become a poor arc start. On the other hand, in the work example 2, since backing movement is certainly continued until ** also reaches the proper retreat distance setting Ls ** or when in contact [the wire head and the distance Lw between weldments when arriving at the welding start location Sp first are very short, and], the above problems are not produced.

[0053] [Work example 3] Invention of a work example 3 explained below corresponds to invention of Claim 3 at the time of application. Invention of a work example 3 is the arc start control approach of performing feeding initiation of the welding wire in invention of the work example 2 mentioned above, and the energization start of the regular welding current Ic from the event of a welding torch returning to the welding start location Sp by carriage return dislodging. Invention of a work example 3 is hereafter explained with reference to Drawings.

[0054] The block diagram of the robot control device RC for enforcing the arc start control approach of a work example 3 and the welding-source apparatus PS serves as the architecture of having changed the synchronous operation controlling circuit SMC of operation as follows in drawing 6 mentioned above, and is the same except it. The synchronous operation controlling circuit SMC of a work example 3 of operation is explained hereafter. [the controlling circuit] while the synchronous operation controlling circuit SMC of a work example 3 of operation outputs the electrical-potential-difference setpoint signal Vs and the feeding

speed setting signal W_s which were beforehand set that the welding start signal St is inputted. If Manipulator RM (welding torch 4) is moved to the welding start location Sp , and it carries out after arriving at the welding start location Sp . If Manipulator RM is moved in the abbreviation feeding direction and a short circuit / arc discrimination signal Sa turns into a short circuit signal, while outputting the output start signal On . If backing movement of the manipulator RM is carried out and a wire head and the distance L_w between weldments reach the retreat distance setting L_s defined beforehand by the above-mentioned backing movement. If the above welding start location Sp is made to carry out carriage return dislodging of the manipulator RM and it returns to the welding start location Sp , while outputting the return signal Rp , the motion-control signal Mc moved in the weld direction to which the manipulator was taught is outputted.

[0055] Drawing 10 is the timing chart of each signal of the robot control device RC of a work example 3, and the welding-source apparatus PS mentioned above. This drawing (A) shows time change of the welding start signal St , and this drawing (B) shows time change of the output start signal On . This drawing (C) shows time change of the feeding control signal Fc , and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa . In a work example 2, it differs, and this drawing (F) shows time change of the welding current I_w , this drawing (E) shows time change of the return signal Rp , and the feeding condition of the welding wire 1 in each [this drawing (H1) - (H5)] time is shown [this drawing (G) shows time change of a wire head and the distance L_w between weldments, and]. In this drawing, since the action before time t_5 is the same as that of the time of drawing 9 mentioned above, description of those periods is omitted. The period after different time t_5 from drawing 9 is explained hereafter.

[0056] In the period time t_5 after time t_5 if a wire head and the distance L_w between weldments reach the retreat distance setting L_s by backing movement. If carriage return dislodging of the welding torch 4 is carried out to the welding start location Sp and it returns to the welding start location Sp in time t_{51} , as shown in this drawing (E), the return signal Rp will be outputted (High level). According to this, as shown in this drawing (C), the feeding control signal Fc turns into the regular feeding speed setting signal W_s of a forward value, and advance feeding of the welding wire 1 is carried out to a weldment 2. [the synchronous power control circuit SINV of operation mentioned above] simultaneously. Since the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal V_s is formed, as shown in this drawing (F), the regular welding current I_c of the high current value corresponding to the above-mentioned regular feeding rate W_s energizes the welding voltage V_w which is not illustrated, while it serves as a value equivalent to the above-mentioned electrical-potential-difference setpoint signal V_s .

[0057] [Work example 4] Invention of a work example 4 explained below corresponds to

invention of Claim 4 at the time of application. When invention of a work example 4 is dislodging in the direction where carriage return dislodging in invention of a work example 2 shortens a wire head and distance L_w between weldments, it is the arc start control approach which energizes migration current I_{b1} of a bigger current value than the regular welding current I_c during between [T_b] these carriage return diakinesis stages. Invention of a work example 4 is hereafter explained with reference to Drawings.

[0058] Drawing 11 is the block diagram of the robot control device RC for enforcing the arc start control approach of a work example 4, and the welding-source apparatus PS. In this drawing, the same code is given to the same circuit block as drawing 8 mentioned above, and those description is omitted. Drawing 8 enclosed with a dotted line explains hereafter the synchronous operation controlling circuit SMC of operation which is a different circuit block, synchronous robot interface circuit SIFR of operation, synchronous welding-source interface circuit SIFP of operation, and the synchronous power control circuit SINV of operation.

[0059] [the controlling circuit] while the synchronous operation controlling circuit SMC of a work example 4 of operation outputs the initial current setpoint signal I_s which is not in the electrical-potential-difference setpoint signal V_s , the regular feeding speed setting signal W_s , and work example 2 which were beforehand set that the welding start signal St is inputted If Manipulator RM (welding torch 4) is moved to the welding start location Sp , and it carries out after arriving at the welding start location Sp If Manipulator RM is moved in the abbreviation feeding direction and a short circuit / arc discrimination signal Sa turns into a short circuit signal, while outputting the output start signal On If backing movement of the manipulator RM is carried out and a wire head and the distance L_w between weldments reach the retreat distance setting L_s defined beforehand by the above-mentioned backing movement, while outputting the retreat distance coincidence signal L_p When carriage return dislodging in the welding start location Sp is dislodging in the direction which shortens a wire head and distance L_w between weldments, the value of the above-mentioned initial current setpoint signal I_s is corrected and outputted to the migration current value I_b defined beforehand. If the above welding start location Sp is made to carry out carriage return dislodging of the manipulator RM simultaneously and it returns to the welding start location Sp , the return signal R_p will be outputted and the motion-control signal Mc moved in the weld direction to which Manipulator RM was taught will be outputted after it.

[0060] [synchronous robot interface circuit SIFR of a work example 4 of operation] The above-mentioned electrical-potential-difference setpoint signal V_s , the regular feeding speed setting signal W_s , the output start signal On , The interface signal If formed from seven signals of the initial current setpoint signal I_s and the return signal R_p which are different in a short circuit / arc discrimination signal Sa , the retreat distance coincidence signal L_p , and a work example 2 is communicated between the welding-source apparatus PS.

[0061] Synchronous welding-source interface circuit SIFP of a work example 4 of operation communicates the interface signal If formed from the seven above-mentioned signals between the robot control devices RC. [the synchronous power control circuit SINV of a work example 4 of operation] The constant current characteristic or drooping characteristic which energizes the current equivalent to the above-mentioned initial current setpoint signal Is is formed and outputted between the event of the above-mentioned output start signal On being inputted, and the event of the above-mentioned return signal Rp being inputted. The constant voltage characteristic corresponding to the above-mentioned electrical-potential-difference setpoint signal Vs for energizing the regular welding current Ic corresponding to the above-mentioned regular feeding speed setting signal Ws is formed and outputted after it.

[0062] Drawing 12 is the timing chart of each signal of the robot control device RC of a work example 4, and the welding-source apparatus PS mentioned above. This drawing (A) shows time change of the welding start signal St, and this drawing (B) shows time change of the output start signal On. This drawing (C) shows time change of the feeding control signal Fc, and this drawing (D) shows time change of a short circuit / arc discrimination signal Sa. This drawing (E) shows time change of back space ***** Lp, and differ in a work example 2, and this drawing (F) shows time change of the return signal Rp. This drawing (G) shows time change of the welding current Iw, this drawing (H) shows time change of a wire head and the distance Lw between weldments, and the feeding condition of the welding wire 1 in each [this drawing (I1) - (I5)] time is shown. In this drawing, since the action before time t5 is the same as that of the time of drawing 9 mentioned above, description of those periods is omitted. The period after different time t5 from drawing 9 is explained hereafter.

[0063] In the period time t5 after time t5, if a wire head and the distance Lw between weldments reach the retreat distance setting Ls by backing movement, as shown in this drawing (E), back space ***** Lp will be outputted (High level). As shown in this drawing (C) according to this, while the feeding control signal Fc turns into the regular feeding speed setting signal Ws of a forward value and advance feeding of the welding wire 1 is carried out to a weldment 2, as shown in this drawing (G), the welding current Iw changes from initial current Is to migration current Ib1. If carriage return dislodging of the welding torch 4 is carried out to the welding start location Sp and it returns to the welding start location Sp in time t51 simultaneously, as shown in this drawing (F), the return signal Rp will be outputted (High level). Since the synchronous power control circuit SINV of operation mentioned above forms the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal Vs according to this As shown in this drawing (G), the regular welding current Ic of the high current value corresponding to the above-mentioned regular feeding rate Ws energizes the welding voltage which is not illustrated, while it serves as a value equivalent to the above-mentioned electrical-potential-difference setpoint signal Vs.

[0064] A wire head approaches a weldment at a rate quicker than the regular feeding rate W_s by addition of carriage return dislodging in the direction which shortens advance feeding by the regular feeding rate W_s , and a wire head and the distance between weldments L_w during between [of time $t_5 - t_{51} / T_b$] carriage return diakinesis stages. For this reason, it can prevent that a wire head thrusts in and contacts to a weldment and becomes a poor arc start by energizing migration current I_{n2} beforehand provided in the bigger value than the regular welding current I_c .

[0065] [Work example 5] Invention of a work example 5 explained below corresponds to invention of Claim 5 at the time of application. [invention of a work example 5] when carriage return dislodging in invention of a work example 2 is dislodging in the direction which shortens a wire head and distance L_w between weldments During between [of the above / T_b] carriage return diakinesis stages, it is the arc start control approach which energizes the regular welding current I_c while a welding torch starts feeding of a welding wire, after energizing migration current I_{b2} beforehand defined corresponding to carriage return movement speed with feeding of a welding wire stopped and returning to the welding start location S_p . Invention of a work example 5 is hereafter explained with reference to Drawings.

[0066] Drawing 13 is the block diagram of the robot control device RC for enforcing the arc start control approach of a work example 5, and the welding-source apparatus PS. In this drawing, the same code is given to the same circuit block as drawing 11 mentioned above, and those description is omitted. Drawing 11 enclosed with a dotted line explains hereafter the synchronous feeding controlling circuit SFC of operation which is a different circuit block.

[0067] The synchronous feeding controlling circuit SFC of a work example 5 of operation will output the feeding control signal F_c which carries out advance feeding of the welding wire at the feeding rate equivalent to the regular feeding speed setting signal W_s , if the return signal R_p is inputted.

[0068] Drawing 14 is the timing chart of each signal of the robot control device RC of a work example 5, and the welding-source apparatus PS mentioned above. This drawing (A) shows time change of the welding start signal S_t , and this drawing (B) shows time change of the output start signal O_n . This drawing (C) shows time change of the feeding control signal F_c , and this drawing (D) shows time change of a short circuit / arc discrimination signal S_a . This drawing (E) shows time change of back space ***** L_p , and differ in a work example 2, and this drawing (F) shows time change of the return signal R_p . This drawing (G) shows time change of the welding current I_w , this drawing (H) shows time change of a wire head and the distance L_w between weldments, and the feeding condition of the welding wire 1 in each [this drawing (I1) - (I5)] time is shown. In this drawing, since the action before time t_5 is the same as that of the time of drawing 9 mentioned above, description of those periods is omitted. The period after different time t_5 from drawing 9 is explained hereafter.

[0069] In the period time t_5 after time t_5 , if a wire head and the distance L_w between weldments reach the retreat distance setting L_s by backing movement, as shown in this drawing (E), back space ***** L_p will be outputted (High level). According to this, as shown in this drawing (G), the welding current I_w changes from initial current I_s to migration current I_{b2} . If carriage return dislodging of the welding torch 4 is carried out to the welding start location S_p and it returns to the welding start location S_p in time t_{51} simultaneously, as shown in this drawing (F), the return signal R_p will be outputted (High level). As shown in this drawing (C) according to this, while the feeding control signal F_c turns into the regular feeding speed setting signal W_s of a forward value and advance feeding of the welding wire 1 is carried out to a weldment 2. Since the synchronous power control circuit $SINV$ of operation forms the constant voltage characteristic corresponding to the electrical-potential-difference setpoint signal V_s as mentioned above, the welding voltage which is not illustrated serves as a value equivalent to the electrical-potential-difference setpoint signal V_s , and as shown in this drawing (G), the regular welding current I_c of the high current value corresponding to the above-mentioned constant feeding rate W_s energizes it.

[0070] Although feeding of a welding wire has stopped during between [of time t_5 - t_{51} / T_b] carriage return diakinesis stages, a wire head approaches a weldment by carriage return dislodging in the direction which shortens a wire head and distance L_w between weldments. For this reason, it can prevent that a wire head thrusts in and contacts to a weldment and becomes a poor arc start by energizing migration current I_{b2} beforehand defined corresponding to the rate of this carriage return dislodging.

[0071] In the work example mentioned above, the case where a welding robot's manipulator was used as a transportation device of a welding torch was explained. However, the X-Y table used for the automatic truck which can move both a welding torch, a weldment, or them to the sliding direction of the feeding direction of an abbreviation welding wire and the horizontal direction of the weld direction, and an NC processing machine can be used, and this invention can also be carried out.

[0072]

[Effect of the Invention] [the arc start control approach of this invention] since the 1st response delay time T_{11} at the time of backing movement initiation of a welding torch and the 2nd response delay time T_{21} at the time of advance feeding initiation of a welding wire can be shortened. While being able to prevent lowering of the productivity by the poor weld by arc length impudence and response delay time in response delay time, an always good arc start can be performed. furthermore, the effectiveness above-mentioned in invention of work examples 2 and 3 -- in addition, even when [whose wire head and distance L_w between weldments when a welding torch arrives at the welding start location S_p first are very short] in contact [case or] Since backing movement is continued until it reaches the proper retreat

distance setting L_s , the poor arc start by the dissipation immediately after the misfire student of the initial arc which retreat distance produces according to a short thing, and birth can be prevented. Furthermore, in invention of work examples 4 and 5, when in addition to both the above-mentioned effectiveness the wire head in between [T_b] carriage return diakinesis stages corresponds to the rate approaching a weldment and energizes the proper migration current I_b , the poor arc start by the inquiry to the weldment at the head of a wire can be prevented.

[Brief Description of the Drawings]

[Drawing 1] The timing chart of a robot arc-welding apparatus which illustrates the form of operation of this invention

[Drawing 2] The block diagram of the robot arc-welding apparatus of the conventional technique

[Drawing 3] The block diagram of the conventional apparatus

[Drawing 4] The timing chart of each signal of the conventional apparatus

[Drawing 5] The timing chart which shows the settlement technical problem of the conventional technique

[Drawing 6] The block diagram of a work example 1

[Drawing 7] The timing chart of each signal of a work example 1

[Drawing 8] The block diagram of a work example 2

[Drawing 9] The timing chart of each signal of a work example 2

[Drawing 10] The timing chart of each signal of a work example 3

[Drawing 11] The block diagram of a work example 4

[Drawing 12] The timing chart of each signal of a work example 4

[Drawing 13] The block diagram of a work example 5

[Drawing 14] The timing chart of each signal of a work example 5

[Explanations of letters or numerals]

1 Welding Wire

2 Weldment

3 Arc

3a Initial arc (generation state)

3b Regular arc (generation state)

3c Arc of excessive arc length

4 Welding Torch

4a Coil liner

DT Delay circuit
Dt Delay signal
Fc Feeding control signal
Ib, Ib1, Ib2 Migration current
If Interface signal
IFP Welding-source interface circuit
IFR Robot interface circuit
INV Power control circuit
Is Initial current (setpoint signal)
Iw Welding current
Lp Back space *****
Ls Retreat distance setting
Lw A wire head and distance between weldments
MC Motion-control circuit
Mc Motion-control signal
On Output start signal
PS Welding-source apparatus
RC Robot control device
RFC Forward reverse feeding controlling circuit
RM Manipulator
Rp Return signal
SA A short circuit / arc discrimination circuit
Sa A short circuit / arc discrimination signal
SFC Synchronous feeding controlling circuit of operation
SIFP Synchronous welding-source interface circuit of operation
SIFR Synchronous robot interface circuit of operation
SINV Synchronous power control circuit of operation
Sp Welding start location
St Welding start signal
T1, T11 1st response delay time
T2, T21 2nd response delay time
Tb Between carriage return diakinesis stages
Td Time delay
VD Voltage detector
Vd Electrical-potential-difference detection signal
Vs Electrical-potential-difference setpoint signal
Vw Welding voltage

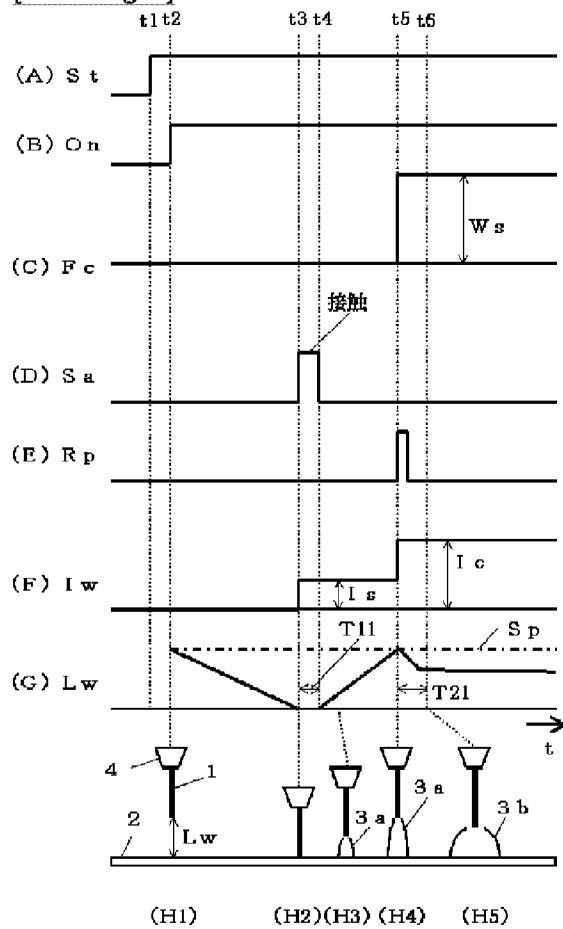
Wi Initial feeding speed setting value

WM Wire feeding motor

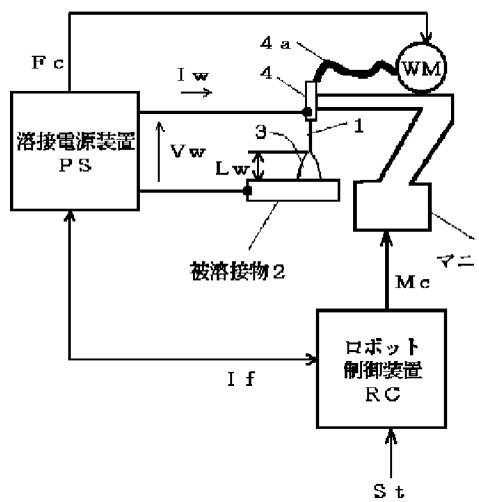
Wr Back space feeding speed setting value

Ws Regular feeding rate (setpoint signal)

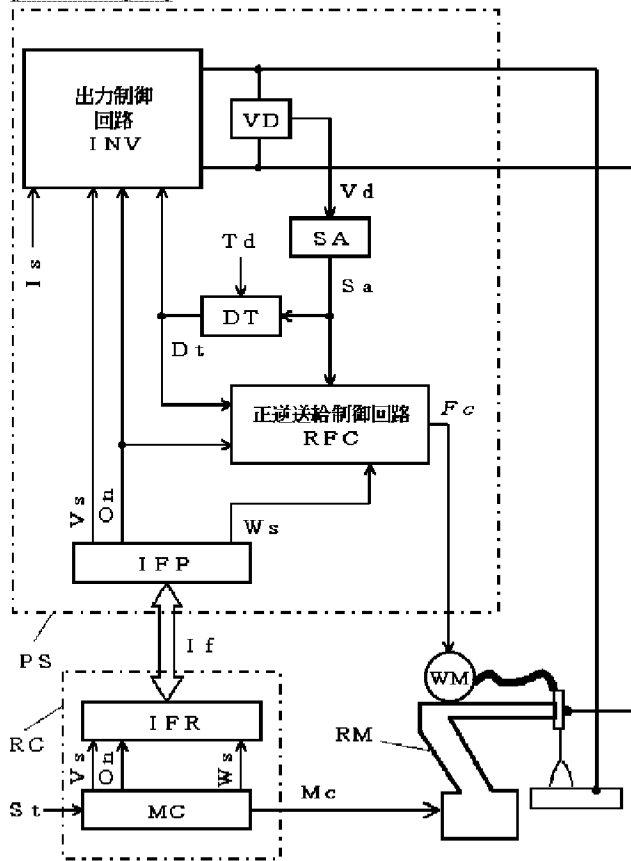
[Drawing 1]



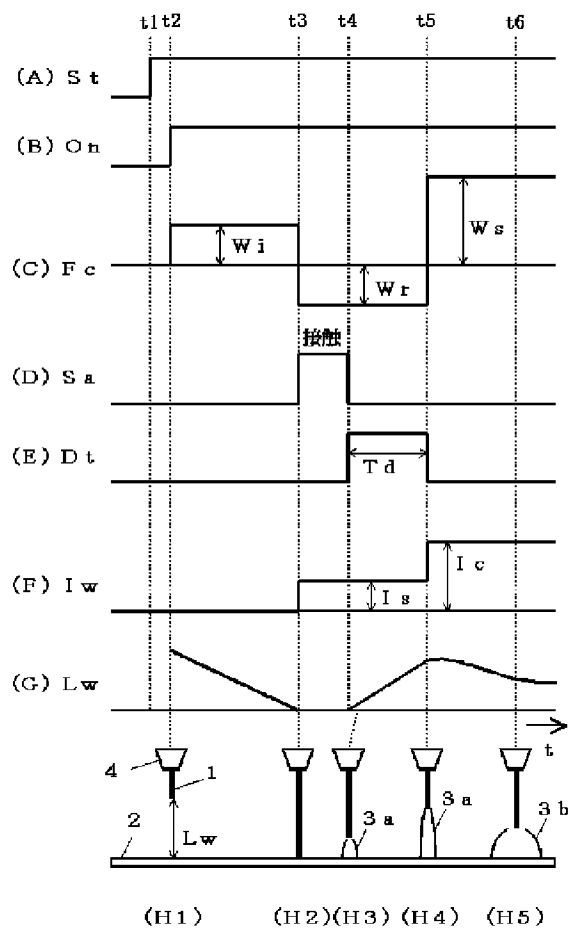
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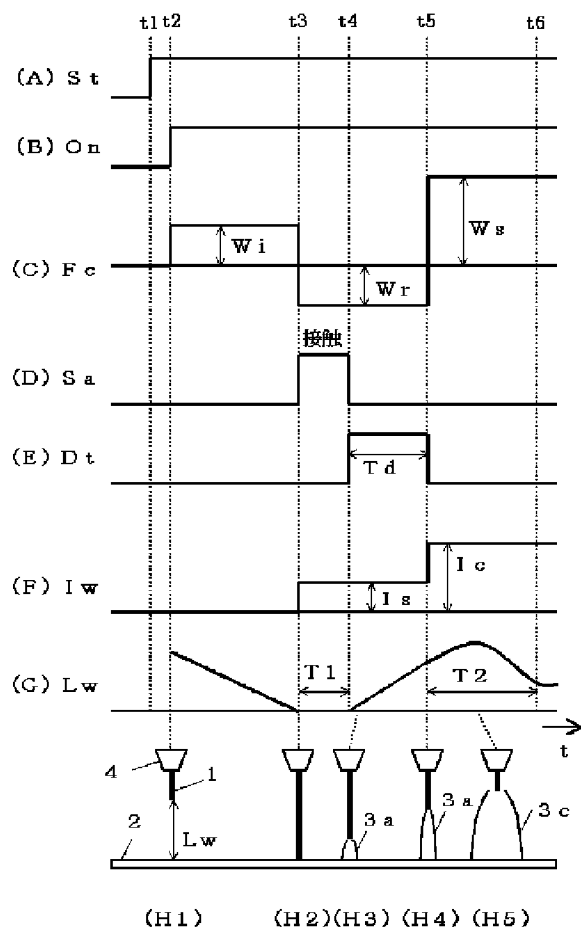
[Drawing 3]



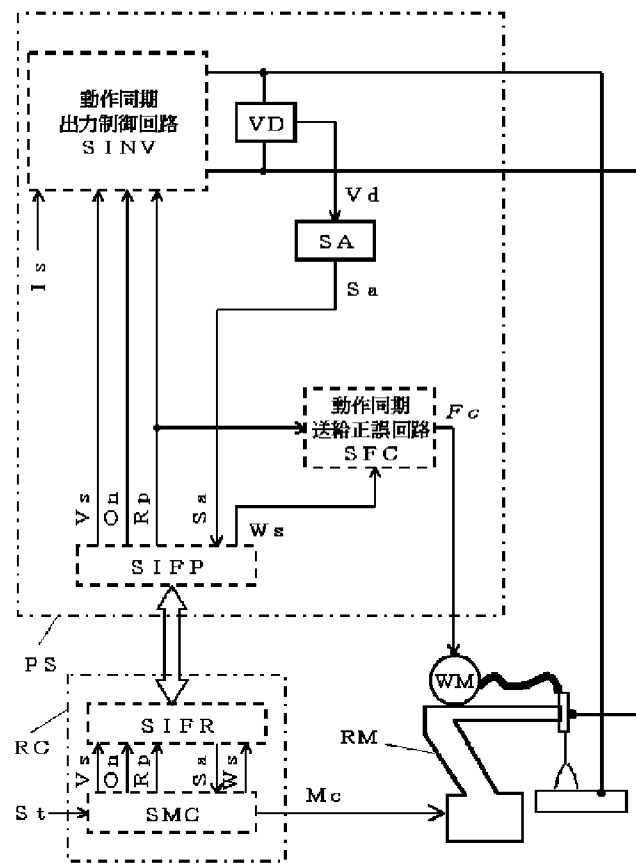
[Drawing 4]



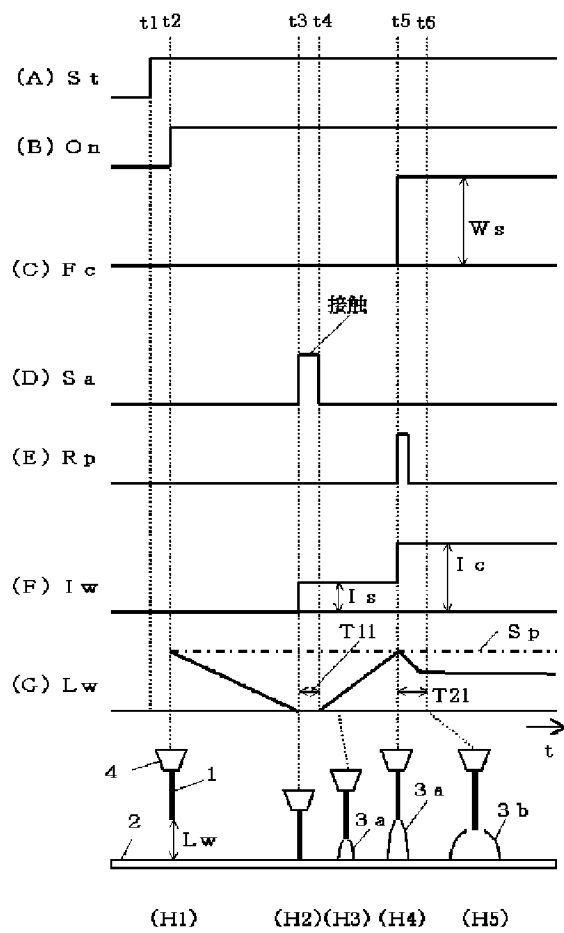
[Drawing 5]



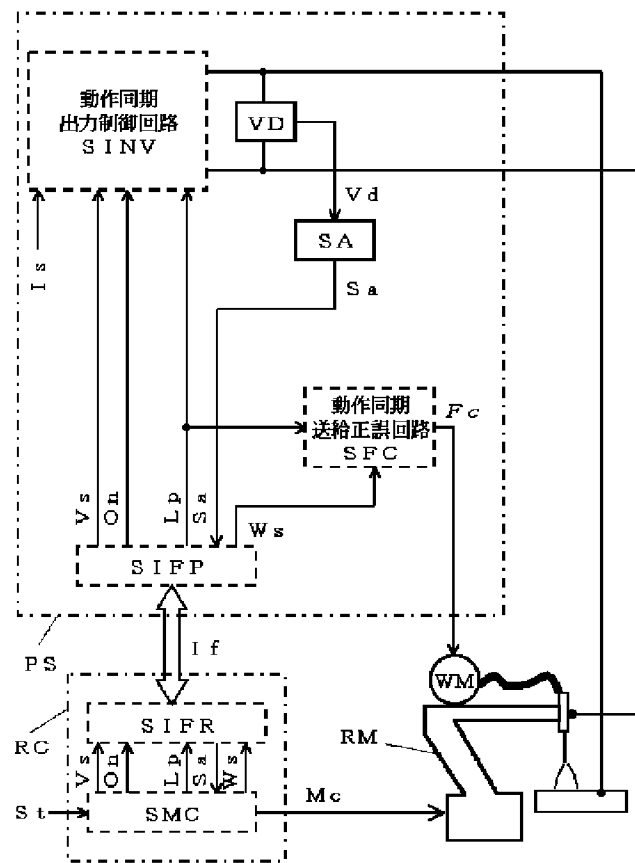
[Drawing 6]



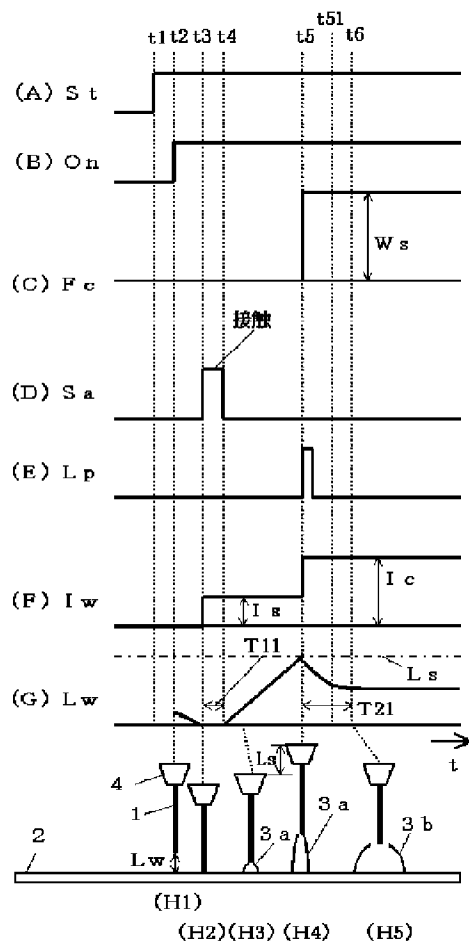
[Drawing 7]



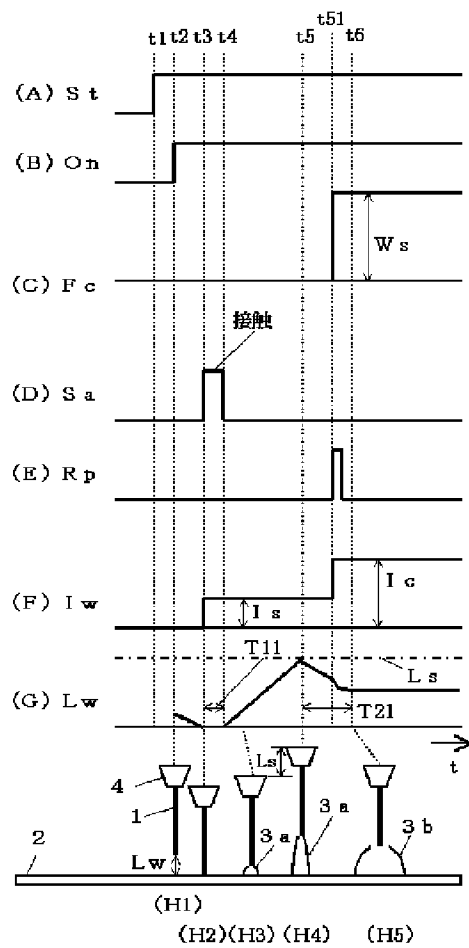
[Drawing 8]



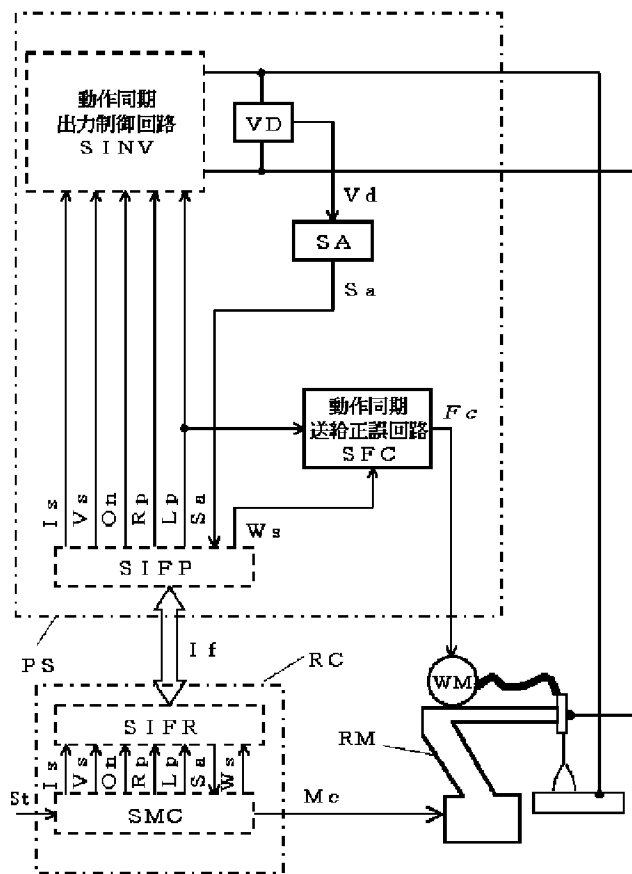
[Drawing 9]

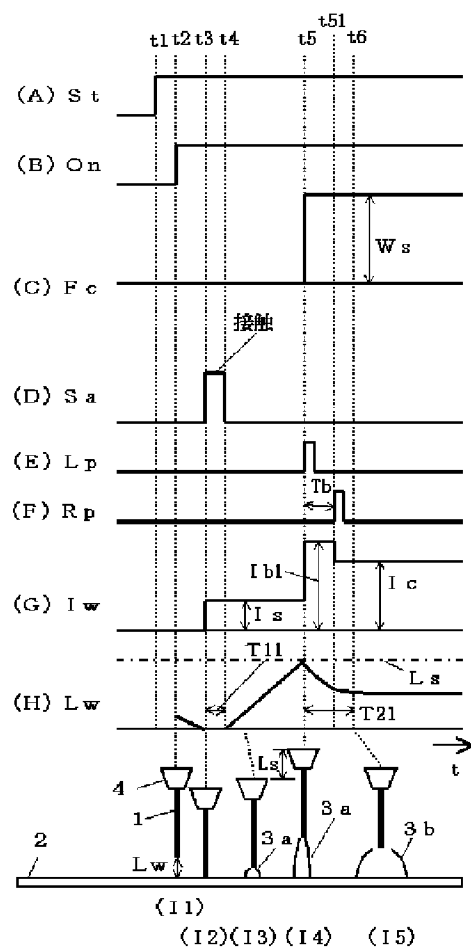


[Drawing 10]

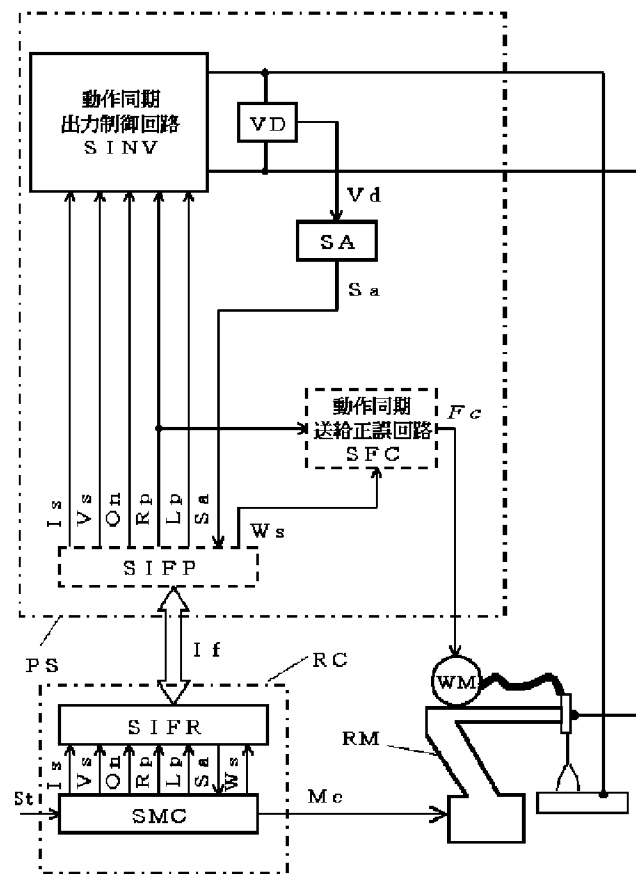


[Drawing 11]

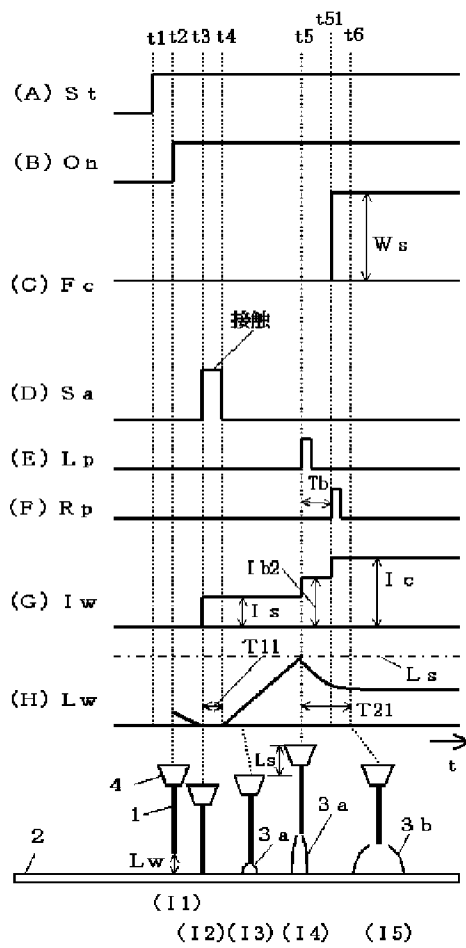




[Drawing 13]



[Drawing 14]



[Translation done.]